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# Air Force Research Laboratory



***Integrity ★ Service ★ Excellence***

## Aging and Surveillance Overview

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# Air Force Research Laboratory

## Aging and Surveillance

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- **Technology reduces system cost and ensures maximum system readiness**
- **AFRL Developing Key A&S Technologies**
  - **Motor state monitoring for production and A&S**
  - **Mechanism based aging calculations**
- **A&S Tech Enables Informed Decision Making**
  - **Enable culling decisions made on individual basis to maximize readiness**



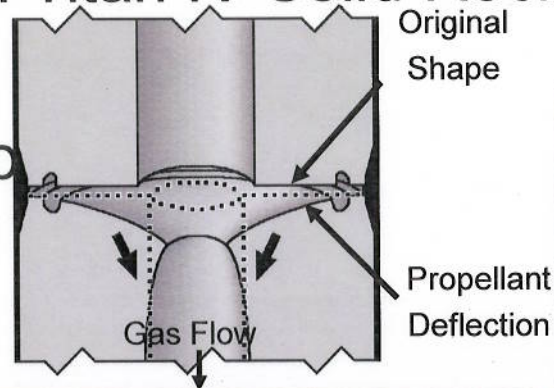


# Aging and Surveillance Programs: Motivation



## Structural-Ballistic Interaction: Titan IV Solid Rocket Motor Upgrade (SRMU) PQM-1

Soft propellant deflects into flow, causes unexpected head-end overpressure



Cost: Test stand damaged, Titan SRM destroyed, ~14 month program delay

## Aging Failure: AIM-7 Sparrow explodes on launch from F-15

Chemical reaction of insulation curative degrades bondline to zero strength  
Resulting structural-ballistic interaction causes missile to explode off wing



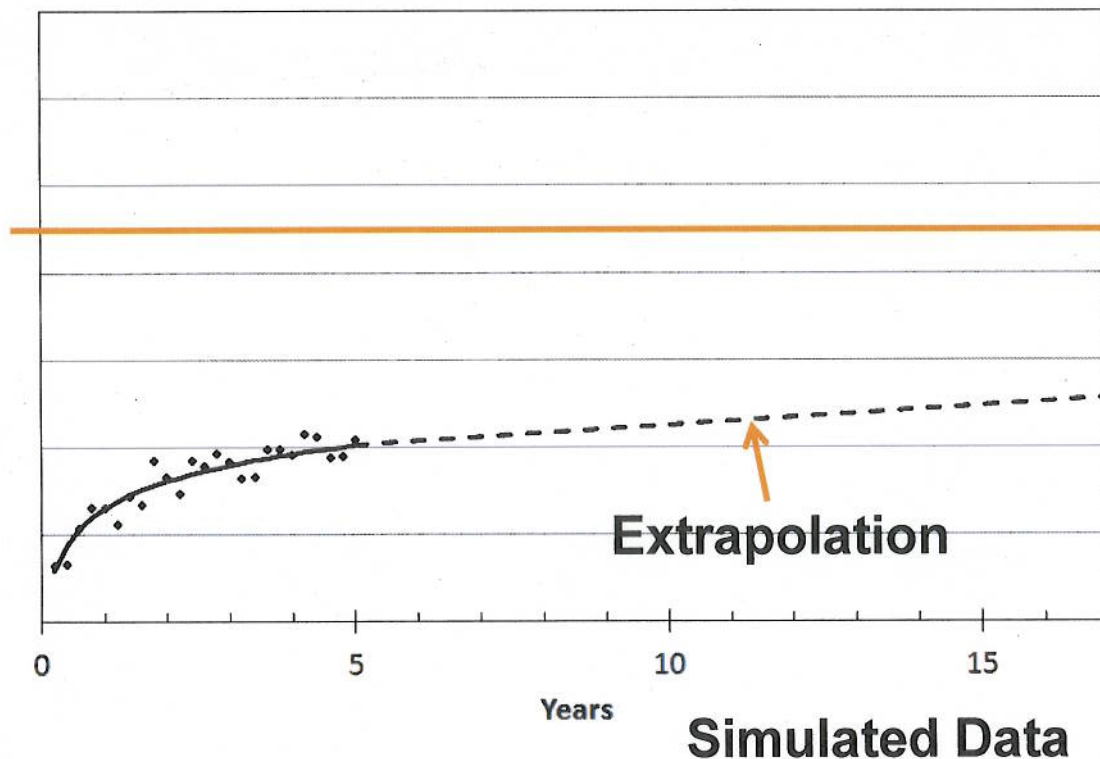
Cost: F-15 damaged, failure investigation



# AFRL Strategic Missile A&S Approach Overview



- Empiricism cannot always predict future state
- Mechanistic method enables enhanced predictions
  - Mechanistic will not be worse than empirical approach



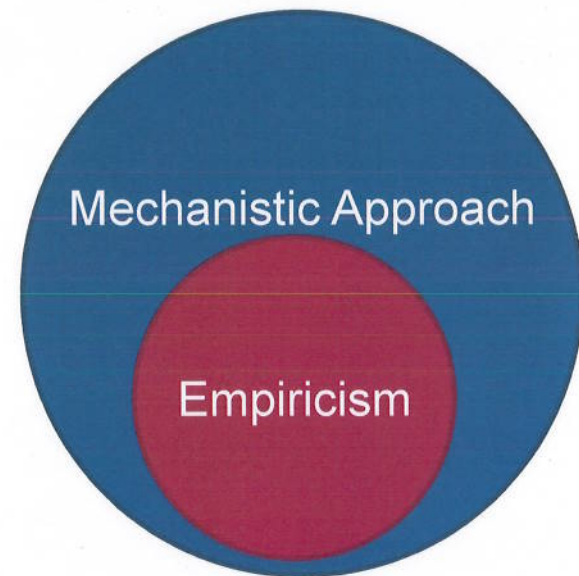
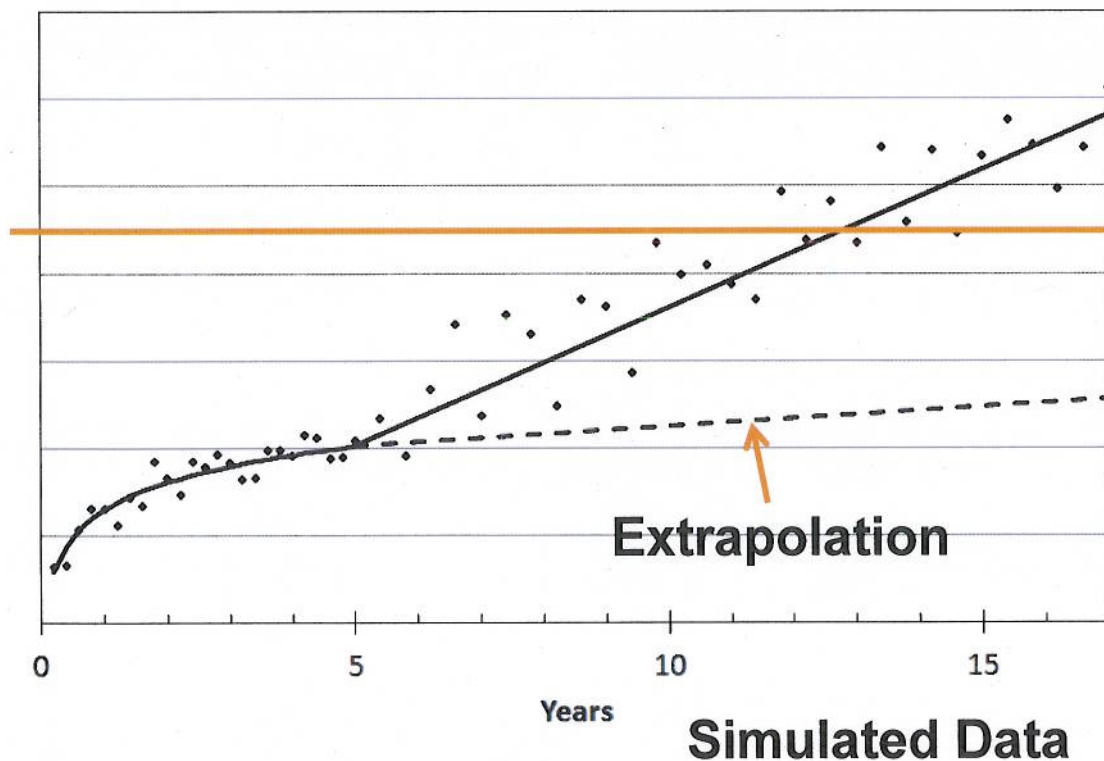




# AFRL Strategic Missile A&S Approach Overview



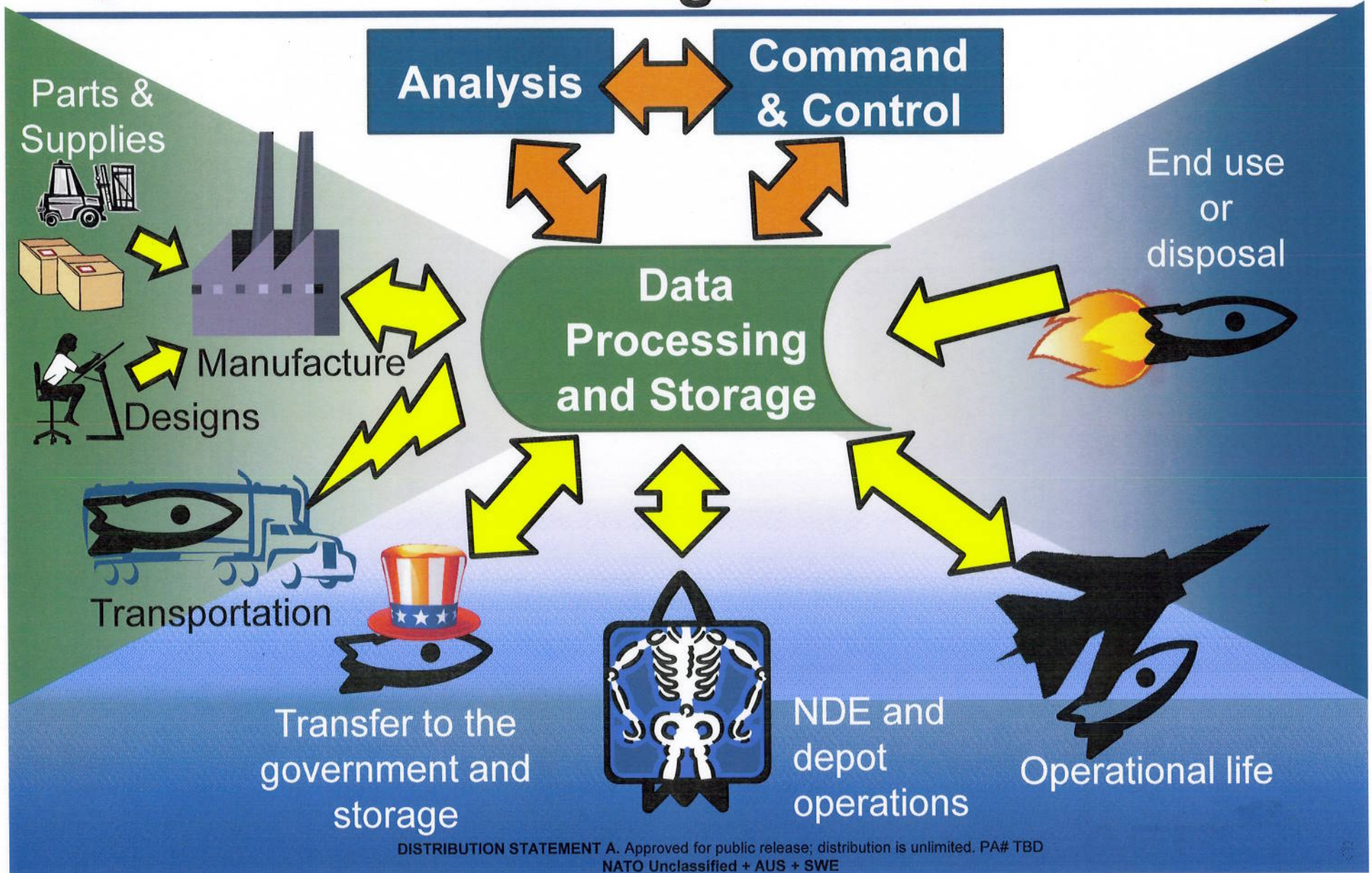
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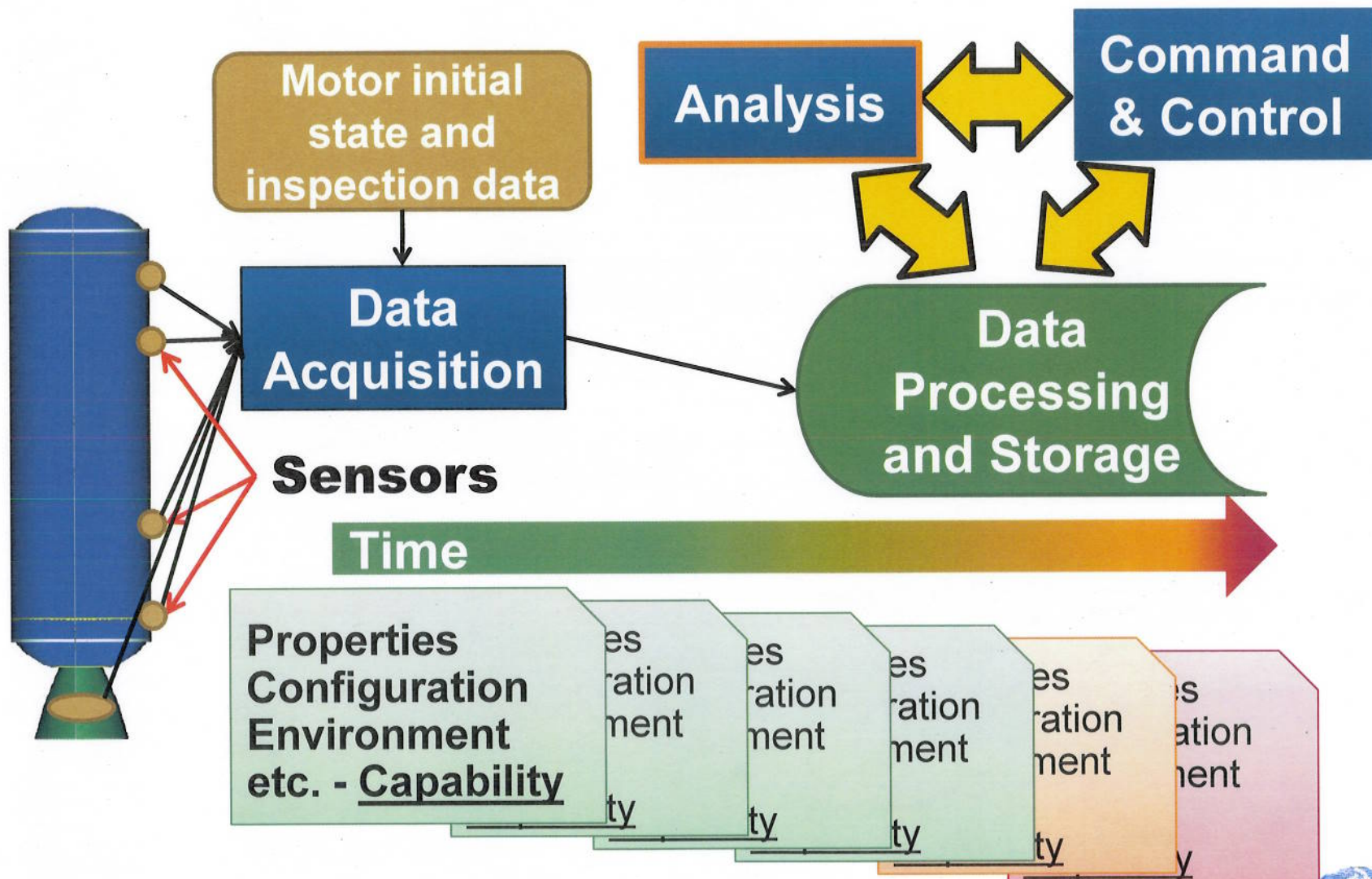
# Cradle to Grave Data Management







# AFRL Missile System A&S







# ARMY Hellfire System



[http://www.eurekalert.org/pub\\_releases/2010-05/dnnl-hcf051910.php](http://www.eurekalert.org/pub_releases/2010-05/dnnl-hcf051910.php)



Photo courtesy of U.S. Army/DOD

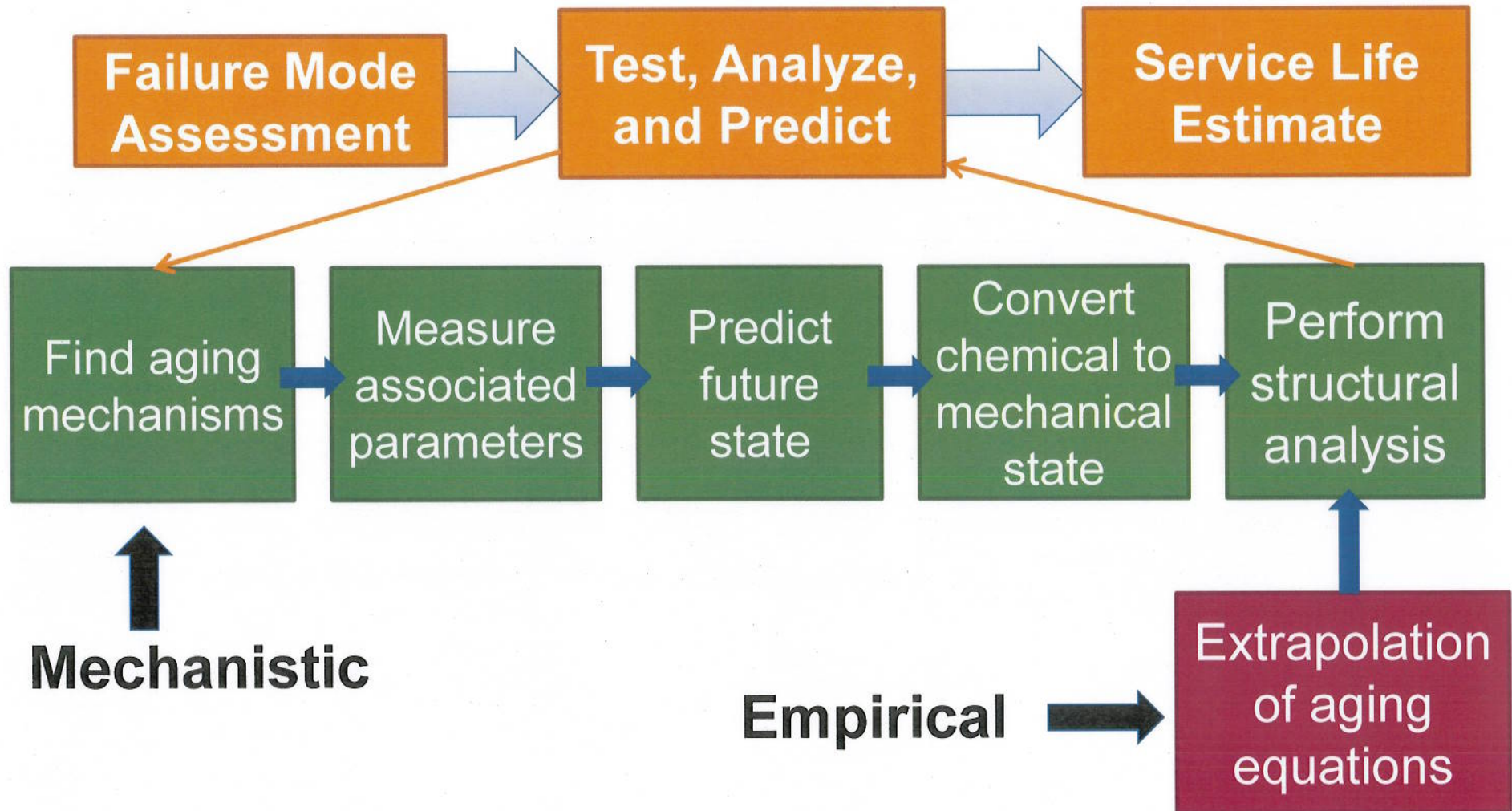
[http://www.redstone.army.mil/amrdec/sepd/ss\\_hellfire\\_CCHM.html](http://www.redstone.army.mil/amrdec/sepd/ss_hellfire_CCHM.html)

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# A&S Predictive Train







# **Integrated Motor Life Management (IMLM) Program Plan**



- **Design a demonstration system to accurately predict the ability of a specific solid rocket motor (SRM) to perform its intended mission**
- **Task 1: Baseline the System**
  - **Identify high TRL sensors, analysis software, and other associated components necessary to deploy a prototype**
- **Task 2: Integration and Assembly of Prototype/Breadboard System**
  - **Assemble prototype/breadboard system using the proposed technologies**



# **Integrated Motor Life Management (IMLM) Program Plan**

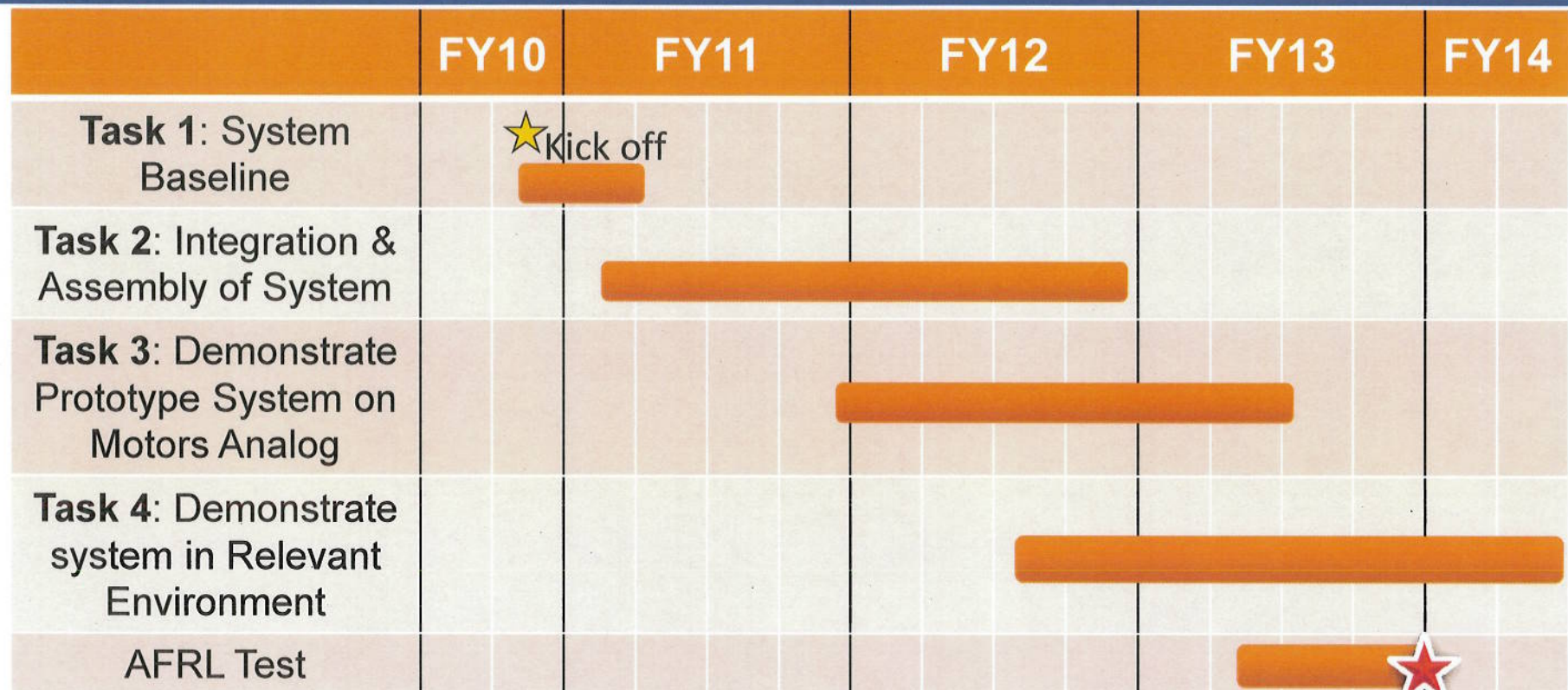


- **Task 3: Demonstrate Integrated Prototype on Motor Analogs**
  - Demonstrate integrated prototype in relevant environments at a laboratory scale – confirm system capabilities
- **Task 4: Demonstrate Integrated Prototype System in Relevant Environments**
  - Subscale motors will demonstrate all aspects of the IMLM system
  - A representative scale motor will be analyzed and monitored while manufactured, aged, transported, transferred to the government, and tested
  - True prediction of performance will be conducted





# IMLM Program Schedule



Demonstrate Integrated Prototype System in Relevant Environments



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